

**Integrated Electric Resource and  
Master Plan Task Force  
Report to Columbia City Council  
November 2021**

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# DRAFT REPORT

November , 2021

To: Columbia City Council

With submission of this report, the Integrated Electric Resource and Master Plan Task Force is completing two of the three major tasks originally assigned to it by Council in 2018. The two completed tasks are the creation of an Integrated Resource Plan (IRP) and Master Plan (MP). The third remaining task, the Cost of Service study, is currently underway but not completed.

The attached report covers highlights, observations and findings made by the Task Force that are derived from the Siemens Industry Inc. (consultant) IRP and MP reports that were completed earlier this fall. Our report is not intended to replace the consultant's report, but rather to provide a perspective on selected topics from that report which the Task Force has deemed worthy of special notice. We do not agree with all the findings presented by Siemens and have pointed those disagreements out. Nor do we have unanimous agreement within the Task Force on every observation and recommendation made, and have introduced minority opinions to help Council understand those divides. Overall, this Task Force report is intended to inform the Council of our thinking regarding these critical issues.

This report represents only a portion of the work we've performed over the last three years. Several hundreds of hours of collective work is embedded in working with staff to develop a request for proposal, in conducting interviews for a consultant, in the selection process, and throughout the many meetings of presentations by the consultant and others, as the report was developed. We provided much feedback and guidance over this time through our discourse with both consultant and staff.

Throughout this development many unanticipated events occurred, such as the Covid 19 pandemic, with numerous attendant logistical and communication changes; through changes to utility administration and staffing, and through several significant utility events, including the record cold weather of February/2021, and the near flooding of the Hinkson Substation in June/2021, and more. All of them, in some way affected, but did not deter, our mission. Most importantly, in the process, the Task Force work and consultant investigations have helped to unveil new information and discoveries that are pointed out in our report.

This has been a unique study to Columbia, unique in how the Integrated Resource Plan and Master Plan and Cost of Service studies have been conducted simultaneously instead of separately, and in the structural aspect of a citizen task force working in such close relationship with utility staff, covering complex subjects and over an extended length of time. In my view these submitted reports demonstrate that we have risen to that task.

After three years and many meetings we are pleased to be delivering both our report and the consultant's report, to Council for its review and use.

Sincerely,

Jay Hasheider, Chair

Integrated Electric Resource and Master Plan Task Force

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## Volume 1: Integrated Resource Plan (IRP)

### Chapter 1: Siemens Executive Summary

### Chapter 2: Overview of IRP Methodology

### Chapter 3: System Load and Energy Forecast

#### ***A. Summary of report content and consultant recommendations***

Siemens created energy consumption and peak load forecasts for the years 2020 to 2040. Both system energy consumption and peak load are projected to grow over the next 20 years, by about 0.8 percent annually, with projected increases declining to 0.7 percent annually by the end of the forecast.

Siemens created forecasts for how energy efficiency (EE) and demand side management (DSM) programs would save energy usage over the same period. Siemens provided three potential scenarios, each of which assumed different levels of energy savings from DSM/EE programs over the next 20 years: 0.8% for the high case, 0.5% for the reference case, and 0.2% for the low case. The report does not currently contain specific information about new programming, basing all estimated reductions on current programs.

Siemens also created forecasts for the estimated adoption of electric vehicles (EV) and the impact of EV adoption on system energy consumption and peak load for the projected period. EV charging is projected to account for between 1.2% (low case) and 8% (high case) of gross load by 2040. The reference case estimate is 1.7% of gross load.

Siemens forecasts the impact that distributed solar (DS) adoption will have on the system, as well as projections for the price of installation and payback times. The projections are that customer owned solar will grow significantly over the next 20 years. In the reference case, it is expected to grow from 4,584 MWh in 2020 to 107,433 MWh in 2040 (reaching 296,958 MWh in the high adoption case).

Siemens combined the energy consumption and peak load forecasts (based on CWL's models) with their estimates of EE/DSM programs, EV adoption, and DS adoption, to come up with projections of net energy consumption and peak load over the next 20 years. Net energy consumption is projected to increase at an average annual rate of 0.3% over the next 20 years. It is expected to decrease slightly in the next ten years, before increasing due to projected EV adoption. Net peak demand is projected to increase at a higher rate over the next 20 years, since DS has a larger impact on total consumption than peak due to the peak occurring at around 5 pm in the summer.

#### ***B. Task Force Majority Opinions and Recommendations***

- The task force notes that net energy consumption and peak load are projected to only modestly increase over the next twenty years. This is in stark contrast to previous IRPs, which projected significantly higher increases. This is in line with the recent history of CWL, where peak load and total consumption have remained relatively stable over the past 10-15 years.
- The Task Force has little disagreement with Siemens findings in this section. We do express disappointment, however, with the lack of proposed future DSM/EE programming in the report. This had been identified as a task in the original scope of work and at the last Task Force meeting with the consultant, they indicated an intention to complete this task, however, there was no

date given and the Task Force is forced to assume that it is incomplete. We do not expect that the section will be forthcoming, especially in time for the Task Force to review any recommendations on future programs.

- Given that the report includes no review of current EE/DSM programming, nor any guidance for new EE/DSM programming, and with little expectation of a significant work if and when it is delivered, we recommend that Council fund a separate study to review current EE/DSM programs and provide guidance to the utility on new programming to meet or exceed the targets set forth in this report.

### ***C. Task Force Minority Opinions***

None

## **Chapter 4: Existing Generation and Supply Contracts**

### ***A. Summary of report content and consultant recommendations***

In this chapter, Siemens provided an overview of current CWL generation assets. CWL's generation assets primarily operate during peaking or emergency times, as most of the electricity requirements for the city are met through Power Purchase Agreements (PPAs). Older assets may not be competitive as import capacity increases and may be targets for closures in the future.

Siemens investigated the possibility of converting Boiler #7 at the Municipal Power Plant to biomass combustion, something previously discussed by CWL. Siemens concluded that this conversion is likely not viable as the price of fuel would be excessive. The University's biomass plant already exhausts most of the regional supply of biomass fuel making it difficult to find sources at an economic price point.

Siemens investigated the possibility of upgrading the Columbia Energy Center to increase capacity. Siemens determined that the upgrades would cost more than the market price for capacity.

Siemens reviewed CWL's current and future PPAs. CWL receives 136 MW of capacity from three coal PPAs. These are life of plant contracts. CWL receives 86 MW of capacity from renewable PPAs. CWL has signed future renewable PPAs totaling 99 MW. The Boone Stephens 64 MW solar PPA is planned to start operation in December 2023. The Iron Star wind PPA (35 MW) is planned to start operation in November 2024 (depending on transmission becoming available). Siemens compared CWL's current PPAs with PPA options available on the market and found that the variable costs of CWL's coal contracts are competitive, though fixed capacity charges were a little bit higher than the current market. Siemens found that the renewable PPAs were in line with those currently available in MISO. Cheaper alternatives are available in SPP, but the point to point transmission charges erode this difference. There is an increasing number of solar projects in close proximity to the city of Columbia, with 2,414 MW of capacity under development.

### ***B. Task Force Majority Opinions and Recommendations***

- The report assumes that the Sikeston coal PPA is going to be retired in 2030 but this does not appear to be certain. CWL staff suggests that 2030 is the absolute earliest the Sikeston plant could be retired, but it is far from a guarantee. The PPA is a life-of-plant contract, and Siemens is not in a legal position to evaluate the contract.
- At this time, CWL should not convert boiler #7 at the Municipal Power Plant to Biomass.
- CWL should not pursue upgrades of the Columbia Energy Center at this time.

- CWL should perform a legal review of all coal PPAs to understand the options available to the utility to meet renewable obligations while under life-of-plant contracts.
- CWL and the city should continue discussions on the future of CWL owned fossil fuel based generation assets.

**C. Task Force Minority Opinions**

None

**Chapter 5: Identification Screening of Future Supply Options****A. Summary of report content and consultant recommendations**

This chapter covers future power options. Eight alternative sources for energy were identified and costs per unit of energy were determined. Table below lists the eight options identified by Siemens from most cost efficient to least.

Potential Future Power Options	Life Cycle Cost per Megawatt-Hour		
	Year 2021	Year 2030	Year 2040
Solar PV (tracking arrays)	\$34	\$30	\$26
Wind PPA	\$34	\$30	\$26
Landfill Gas (limited by fuel availability)	\$53	\$53	\$53
Nat Gas (Reciprocating Internal Combustion Engine)	\$76	\$80	\$84
Lithium Ion Batteries	\$109	\$80	\$70
Biomass (limited by fuel availability)	\$103	\$100	\$98
Natural Gas Aero Cycle LM 6000	\$98	\$104	\$115
Natural Gas Aero Cycle LM 2500	\$138	\$143	\$150

**B. Task Force Majority Opinions and Recommendations****C. Task Force Minority Opinions**

One member disagreed with the cost provided in the table above.

**Chapter 6: Resource Generation Plan****A. Summary of report content and consultant recommendations**

A unique feature of this report is the use of eight scenarios to forecast potential futures for Columbia's power projections. Each scenario incorporates a distinct mix of economic and demographic inputs to formulate a prediction of utility loads over the next 20 years that is matched with a portfolio of

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generation sources. In their analysis Siemens depicts the impacts to Columbia's energy environment within each scenario and concludes the chapter with estimates of total costs for all eight scenarios over their 20-year planning horizon. A table of the scenarios is below, listed by costs from least to highest. More detail of all scenarios can be found in the Siemens report.

Scenario	Description of Energy / Capacity mix	Total Costs 20 years NPV (\$Million)	Cost Compared to Reference ( %)
High Tech	New developments in nat gas extraction as well as in EVs, renewable energy, and in energy efficiency	\$688	94.6 %
Recession Economy	Poor economic conditions, slow de-carbonization, low investment opportunities	\$705	97.0 %
<b>Reference Case</b>	CWL achieves 100% Renewables by 2050, Columbia achieves 80% CO2 reduction by 2050 and 100% by 2060	\$727	0.0 %
High Regulatory	High CO2 cost, natural gas fracking becomes regulated, high level of energy efficiency	\$763	105.0 %
Early Renewable	CWL achieves 100% renewable energy by 2030. High EV penetration and high level of energy efficiency	\$777	106.9 %
Mid Renewable (w/ high CO2 costs)	CWL achieves 100% renewable energy by 2040. High EV penetration and energy efficiency	\$781	107.4 %
Early Renewable (w/ high CO2 costs)	Same goals as Early Renewable scenario but with high CO2 costs (with cost increases affecting fossil fuels)	\$789	108.5 %
High Growth	Weather (especially warmer summers) drives loads and capacity needs. Regional electric use rises driving market prices high	\$838	115.3 %

### B. Task Force Majority Opinions and Recommendations

- The scenarios provide eight different paths that could occur. The inherent difficulty is that selecting any one of them is a guess of our future as they are all complicated by real-world inputs that are beyond Council's control. For example, Council does not control federal mandates nor regional economic conditions which are two of the inputs into the scenario matrix. There are a total of seventeen inputs in all. Another option for council would be to provide directions on inputs in which it does have control over. These include when goals for 100% renewable energy and carbon reduction should be achieved, or which levels (high,medium,low) of energy efficiency programming and electric vehicle penetration should be targeted. Staff could then incorporate those directives into actions and portfolios by adopting future development that is best aligned with the scenarios incorporating council's decisions.

- The Task Force recommends that the City Council pursue a revision or replacement of the Renewable Energy Ordinance, setting a date for the utility to achieve 100% Renewable Energy **by the earliest practical date**, which should provide staff with needed direction for future programming and power supply acquisitions.
- The Task Force also recommends that staff pursue programs and action to achieve the higher targets for Demand Side Management (DSM), Energy Efficiency (EE), and Distributed Energy (DE) that are identified in the report.

### ***C. Task Force Minority Opinions***

- Task Force minority opinion is preference for the Early Renewable scenario. We recognize that this may be difficult to achieve and, if that proves to be the case, to strive for a 100% renewable energy portfolio by the earliest date possible. (2 members shared this view)

## **Chapter 7: MISO vs. SPP Membership Assessment**

### ***A. Summary of report content and consultant recommendations***

Siemens was asked to evaluate the CWL association with Regional Transmission Organizations and whether CWL should consider joining the Southwest Power Pool (SPP) instead of continuing their association with the Midcontinent Independent System Operator (MISO). Analysis was performed utilizing the above referenced scenarios.

Based on the Reference Case, Siemens concluded that potential wheeling costs would far exceed the potential savings from lower PPA prices by joining SPP (page 136). Wheeling charges are the cost for importing energy from another RTO. SPP's charges are somewhat higher than MISO's. However, under the Early Renewable scenarios CWL has the most potential to benefit from joining SPP with 100% of the load being supplied by renewable generation in 2030 (page 136).

### ***B. Task Force Majority Opinions and Recommendations***

- Columbia joined MISO at its formation in early 2000s. Columbia's location is near the border between MISO and SPP, but with most of the existing power contracts residing within the MISO territory, it was logical to join the MISO operations.
- The option of moving Columbia to the Southwest Power Pool (SPP) should be revisited after Columbia makes a decision regarding renewable energy goals. This would influence the amount of coal based energy that would need to be imported and hence the amount of wheeling charges to be incurred.
- When the decision is made on CWL goals, the issue of joining SPP should be reviewed approximately 8 years in advance of reaching 100% renewable energy.

## **Chapter 8: Value of Solar (VoS) Study**

### ***A. Summary of report content and consultant recommendations***

Utility Financial Solutions, LLC (UFS) was engaged by the Siemens team to provide guidance on the



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valuation of solar for the City of Columbia Water & Light (CWL). UFS used the avoided cost/utility savings methodology to calculate the values, considering short-run marginal costs. The savings were calculated by solar weighted market pricing, variable transmission costs, predicted capacity purchases savings plus distribution system loss savings.

The purpose of this report is to identify the average kWh value of electricity produced by customer installed fixed array rooftop solar. There are many factors and considerations for calculating the current and potential future value of solar. With the study based on current market pricing UFS recommends that the value be updated annually or updated as a part of the CWL rate making process or when significant assumptions change.

The study was carried out using the following assumptions:

A) The following Solar Value Components assessed were:

**Table 25: fixed array: Value Breakdown**

Solar NREL Fixed Roof Mount 7.95 KW DC		
With Loss Savings (behind customer meter)		
Annual	per kWh	
\$ 265.20	\$ 0.02422	Energy Value (CLWD hrly price node for 2021)
\$ 16.98	\$ 0.00155	Capacity (1 CP X 6 Year av annual auction
\$ 3.31	\$ 0.00030	Transmission - Delivery
\$ 19.43	\$ 0.00178	Delivery
\$ 304.92	\$ 0.02785	Total Average KWh Value

For smaller customer installed rooftop fixed arrays the VoS was calculated to be 2.8 cents per kWh. The detailed calculations and assumptions used in the analysis are listed in subsequent sections of the report. Large solar installs (as defined by CWL policy) should be valued on a per case basis. Energy savings value portion is expected to be 2.4 cents per kWh.

UFS provides below general recommendations that CWL should consider when integrating distributed solar to its system:

- i. Eventual move for all customers toward rate structures having a demand or Time of Use (TOU) component
- ii. Right sizing - (within allowed sizing of CWL's interconnection policy), for example allow solar install up to lesser of 100% of a customer's peak demand "before solar" or 100% of a customer's average annual kWh usage "before solar" (net zero)
- iii. Metering, billing and strategies: Final metering and billing options selected by CWL are ultimately based on their management and governing Body preferences. It is often based on a combination of philosophy preference as well as metering and billing capabilities of CWL. Many utilities are adopting multiple approaches depending on the size of solar install. The most common method for smaller, rooftop solar installations is net billing. The most common

method for larger solar installations is buy-all-sell-all – (This is the closest to provide services at cost of service.) Many utilities, however, are moving toward a more robust rate structure. At a minimum, all rates (including residential rates) should evolve to include demand component(s). In general, the closer CWL can get their kWh retail rate (energy component) to match their marginal power supply costs, CWL should be more indifferent to customer-installed generation.

- iv. It is critical to consider battery value based on utility demand management vs power quality in future studies.
- v. CWL management should track and allocate future costs to be charged back in support of distributed solar for the basis of updating the future value of solar calculation.

UFS recommended the following for inclusion in a future study:

The State of Missouri currently does not have a formal Renewable Energy Credit (REC)/Solar REC program. **UFS recommends that CWL explore the REC/SREC value for solar to be studied.** If self-directed benefit by CWL, this may need to be paid by other CWL rate payers. Currently, RECs have a value to CWL and have spent money on RECs for RES compliance, which was not reflected here.

**UFS recommends that CWL explore the value of solar with batteries.** The maximum battery value is usually calculated by charging and discharging the battery around reducing the utility capacity and/or transmission peaks (“utility demand management or peak shaving”) or achieving energy arbitrage. If this cannot be accomplished, it is actually possible for a battery to have lower and even a negative value. This is due to energy loss when a battery is charged and discharged. This is often referred to as battery “round trip efficiency”. It is common to lose around 15% of the electricity when storing and discharging a battery.

Depending on a variety of factors, it may be useful to configure an appropriately sized battery to be integrated with the renewable generation and configured to operate as a “power quality” battery vs. a “utility demand management or peak shaving” battery to support power quality. This often depends on a variety of factors such as the size of distributed generation resource, percent of renewables penetration vs. non-renewable, minimum and maximum feeder loadings vs. total renewables. Batteries run in power quality or blended mode generally do not realize as high of value due to their reduced ability to maximize utility demand management savings.

Potential **environmental and social values** were not considered in this study. This is due to these values not currently being identified as an actual expense to the utility. It is possible that future requirements may be introduced to have an actual dollar value to the costs of the utility. It is recommended that CWL consider adding this potential, future value if it becomes a true cost. Some utilities are electing to add this value on their own. This would be at the discretion of CWL Management and Governing Body. **UFS recommends a study if this becomes the case.**

### ***B. Task Force Majority Opinions and Recommendations***

- **Task Force recommends Council not rely on this value of solar study** to represent the total value of solar in Columbia
- Task Force recommends a follow-up study be conducted to include a wider set of input variables to reflect the interests of the community, primarily environmental and societal valuations.
- Task Force expectations were that the study would include environmental and societal values. These were not conveyed to the consultant’s sub-contractor. As a result, the value for solar in

Columbia was ranked at the lowest end compared to 11 other Values of Solar, in a 2016 study (figures 1&2 in Appendix A). The consultant's report is not a comprehensive representation of values for solar in Columbia.

- In the current state, the VoS study cannot be used to advance any environmental or climate goals and could potentially be used to advocate against local photovoltaic investments in Columbia and other locales.
- Missing variables in this study include avoided base load plant, O&M, grid infrastructure savings, ITC federal tax credit consideration, job creation, grid reliability/resiliency, and societal & environmental benefits including consideration for the goals set forth under Columbia Climate Action Plan findings.

### **Chapter 9: AMI and Smart Grid Assessment**

#### ***A. Summary of report content and consultant recommendations***

The U.S. Department of Energy (DOE) describes the Smart Grid as “an intelligent electricity grid—one that uses digital communications technology, information systems, and automation to detect and react to local changes in usage, improve system operating efficiency, and, in turn, reduce operating costs while maintaining high system reliability.”<sup>1</sup>

One foundational component of the smart grid is Advanced Metering Infrastructure (AMI). The U.S. Department of Energy calls AMI an “integrated system of smart meter, communications networks, and data management systems that enables two-way communication between utilities and customers” which has “the ability to automatically and remotely measure electricity use, connect and disconnect service, detect tampering, identify and isolate outages, and monitor voltage...AMI also enables utilities to offer new time-based rate programs and incentives that encourage customers to reduce peak demand and manage energy consumption and costs.”

The Siemens’ AMI and Smart Grid Assessment provides an extensive list of benefits:

##### *Benefits to Customers*

- ☐ Quicker notification of service problems
- ☐ On-demand meter reading
- ☐ Customer usage portal with hourly usage data
- ☐ New rate structure enablement
- ☐ Prepaid metering options
- ☐ Home energy management solutions
- ☐ Modern demand response programs

##### *Benefits to Electric Utility*

- ☐ More efficient service restoration
- ☐ High & low voltage notifications
- ☐ Improved system monitoring
- ☐ Reduced utility revenue loss

- ☐ Reduced system demand & energy loss

**Benefits to Water Utility**

- ☐ Eliminates visual reading of meters
- ☐ Eliminates ad hoc replacement of failed batteries
- ☐ More efficient use of customer service reps time
- ☐ Improved system monitoring
- ☐ Reduced utility revenue loss
- ☐ Better matching of supply and demand to reduce energy usage/cost
- ☐ Better pressure management

**Benefits to Other Areas**

- ☐ Positive contribution to Columbia's CAAP including less vehicle usage for meter reads

Siemens recommends that CWL should immediately stop installing the Itron Bridge Electric meters. This meter platform may be reliant on a communications technology in the process of being retired by the manufacturer.

Siemens also recommends that CWL issue a request for proposal for an AMI System project, the likely savings to CWL could approach \$6-8 million through the competitive bid process.

Summary of capital investment using existing contracts and unit prices:

Electric Meter Infrastructure & Install Costs	\$22,804,870
Water Meter Infrastructure & Install Costs	\$7,711,635
Communication Infrastructure & Install Costs	\$335,000
AMI Software	\$1,261,000
<b>Total Capital Investment</b>	<b>\$32,112,505</b>

**B. Task Force Majority Opinions and Recommendations**

- The Task Force agrees with Siemens' recommendation to stop installing the Itron Bridge Electric meters as soon as reasonably possible. The Task Force recommends the City Council direct CWL to confirm Itron's technology roadmap for the Itron Bridge Electric meter compared to the vendor's current communication's system offerings. This meter platform may be reliant on a communications technology in the process of being retired by the manufacturer.
- The Task Force agrees with Siemens' recommendation that CWL issue a request for proposal for an AMI System Project as soon as reasonably possible. The Task Force acknowledges that the deployment of an AMI system will likely be a multi-year project.
- The Task Force recognizes that the capital investment associated with an AMI System Project must be weighed against other utility system needs and the city's financial constraints and therefore cannot be implemented immediately.

**C. Task Force Minority Opinions**

None

## Volume 2: Master Plan Transmission and Distribution

### Chapter 3: Spatial Load Forecast:

### Chapter 4: Substation Expansion and Coverage Areas; and

### Chapter 5: Distribution Network System Assessment

#### ***A. Summary of report content and consultant recommendations***

In these chapters, Siemens evaluated the CWL electric distribution system. This assessment included system load forecasts and evaluation of substation coverage areas with recommendations for needed updates to the distribution network-increased use of electric vehicles were also evaluated. Siemens provided a detailed distribution system network analysis with recommendations to address potential overloading conditions both in normal forecasted growth and emergency system conditions.

Siemens concluded that there are no significant distribution overload concerns in the short term of less than 5 years, however substation and feeder expansion projects will be needed by 2030 to avoid overload issues at the Perche, Blue Ridge, Grindstone, Hinkson, Rebel Hill, and Bolstad substations.

Up to 77.8 MW of additional distributed solar power is forecasted within the service territory by 2040 with most installed by commercial customers. This installed solar will help offset some load growth.

Siemens also determined that a new substation, including the previously proposed Millcreek substation, is no longer necessary if the distribution system is updated and re-balanced per Siemens recommended capital projects and improvements to address anticipated growth and overload conditions.

A total of \$51 million is estimated for projects over the 20-year study period, with most projects, approximately \$41.5 Million recommended within the next three to five years. Projects include: additional and upsized circuits, added distribution and transmission level transformers, and more distribution capacitors for voltage and power factor management.

Siemens did explore a Non-Wired alternative as part of the distribution system evaluation for an area south of Perche Creek substation, however it was determined to be a much higher cost at this time compared to a standard wired solution.

#### ***B. Task Force Majority Opinions and Recommendations***

- The Task Force agrees with the updated modeling, engineering design standards, spatial load forecast, and the level of detailed analysis of the distribution system completed by Siemens.
- The Task Force supports the recommended distribution upgrade projects to address load growth. The Task Force recognizes completing \$41.5 million in distribution system projects with the next three to five years is not logistically or financially realistic. The CWL engineering staff shall continue to evaluate and prioritize each of the recommended projects to strategically include within the CWL's capital planning process.
- The Task Force agrees with Siemens that the proposed Mill Creek Substation is no longer needed if the recommended distribution projects are implemented. However, we recognize another

distribution substation may be needed within the community during the next 20 years depending on growth.

- The Task Force recommends that CWL shall maintain its distribution planning and engineering effort to ensure the system continues to provide reliable, safe and cost effective service.
- The Task Force recommends that CWL consider Non-Wired alternatives for future distribution projects where applicable as the costs of these technologies are expected to be more competitive in the future.
- The Task Force does not recommend any specific Council actions at this time. Distribution projects will be brought to the Council per the capital project planning and approval process already in place.

### **Chapter 6: Transmission System Assessment**

#### ***A. Summary of report content and consultant recommendations***

The transmission study was carried out over a 10 year time horizon assuming summer peak loads listed below. Modeling was conducted without deployment of the Columbia Energy Center or Plant Generation).

<u>Year</u>	<u>Predicted Peak Load for Transmission models</u>	
Year 2020	273.1 MW	
Year 2025	274.7 MW	(would be 276 MW without distributed generation)
Year 2030	274.2 MW	(281 MW without distributed generation)
Year 2030 (high load)	296.0 MW	(300 MW without distributed generation)

Siemens studied the following transmission options in their modeling:

**Option Z:** Building a 161kV line connecting Perche Creek and Grindstone substations. This option is a revision of the original Option A, with the 161KV line between Perche and Grindstone kept to its originally proposed route, however the Mill Creek substation was removed as Siemens determined that a new substation was not needed at that location. Also removed was a second 161kV line that existed in the original Option A connecting the proposed Mill Creek substation to the McBaine substation.

**Option B-2:** Building a 161 kV line connecting Perche Creek substation to McBaine substation. Approximately 40% of this route is owned by the City which would reduce costs associated with property acquisition.

**Option E-2:** Building a 161 kV line connecting Perche Creek substation to Bolstad substation.

**Option F:** Creating a 345 kV interconnecting line between an existing Ameren substation west of town and the Perche Creek substation.

**Option W:** Rebuilding the existing 69kV line between Perche Creek and Hinkson Creek substations to carry both the existing 69kV line and a new 161kV line. Additionally, building a 161kV connector between Hinkson substation and Grindstone substation. This option keeps the existing 69kV line, and adds a new 161kV line on the existing route.

**Option NWA:** Building a 30 MW photovoltaic array (presumably located west of Columbia) and installing 27 MW of energy storage, with a Point of Interconnection (POI) at Perche Creek substation. This option is added as a reference as it was analyzed in the Master Plan B.

Siemens ranked the above options from a technical point of view with consideration for their ability to handle forecasted loads with N-1-1 vulnerabilities, and for other parameters. Option W ranked higher than Option F (see report for ranking details). Option F would require interfacing with Ameren.

Siemens also ranked the options by cost. Option Z was the least cost option, followed by F and then W (see report for details)

In their analysis of our transmission system Siemens determined it is currently in compliance with NERC (North American Electric Reliability Corporation) requirements and will continue to be in compliance for the foreseeable future, without any changes to the transmission system.

Siemens identified two scenarios which could create the need to shed load. Load Shedding is the controlled reduction of power to selected portions of the distribution system on a rotating basis. These scenarios involve failures at two points in the transmission system, an N-1-1 situation. The two scenarios identified would involve failures occurring simultaneously at critical points and during times of high load and would require the utility to shed load. Siemens estimated the likelihood of these events occurring is approximately every 100-200 years.

The City has an acceptable load shedding plan in place should we ever need to deploy it. Implementing the load shedding plan may become necessary should a “do nothing” option be chosen.

The previously proposed Mill Creek substation is no longer necessary. In the event we decide to add a substation on the south side of the CWL service territory, Siemens recommends identifying a location that is further to the south and west, closer to the water treatment plant.

In general, load growth over the planning horizon is expected to move towards the northeast of the transmission system.

The University of Missouri may request up to 40 MW of firm capacity in the future.

### ***B. Task Force Majority Opinions and Recommendations***

- The Task Force recognizes that since CWL is in compliance with all NERC requirements, the utility is not required to do anything to our system to remain in compliance for the foreseeable future.
- Option W (described above) provides the flexibility to accommodate potential capacity requests from the University of Missouri in the future. It also incorporates a rebuild of the Hinkson substation which is highly recommended due to the flooding vulnerabilities that were demonstrated in the flash-flood event of June 2021. It could also likely prevent the need for potential load shed in an N-1-1 contingency.
- If the CEC (Columbia Energy Center) dispatch is considered as part of the utility response in N-1-1 transmission contingencies, Option W should be capable of handling all modeled events throughout the planning horizon.
- Option F has best “ranking score” (lowest load value) according to Siemens analysis, indicating that it results in the lowest loading of the critical elements for the various contingencies and scenarios. However, the costs of interconnection with Ameren are unknown, and costs to own and maintain 345kV equipment and line could mean increased operations and maintenance costs.
- A majority of Task Force members supported putting Option W forward as our first recommendation to Council, with agreement for Option F and B2 being secondarily recommended, but in no particular order. The Task Force conducted a poll of its members to gain insight into opinions regarding covered options. The results of the poll are presented in a matrix in Appendix.

## **C. Task Force Minority Opinions**

There was a minimal amount of support (2 votes) for the Non-Wires Alternative identified by Siemens.

*An additional minority opinion has been submitted which highlights the merits of Non-Wires Alternatives. This opinion remains to be reviewed by the Task Force before submission of final report*

## **Chapter 7: Standards Review**

## **Chapter 8: Capital Projects**

### **A. Summary of report content and consultant recommendations**

The Siemens Master Plan's Capital Project summary appears in Chapter 8. It is divided into sections for Transmission investments, and Distribution investments. Each of the capital projects described in this section pertain to specific projects identified in Chapter 5 and are only referenced in this Chapter according to the number assigned in Chapter 5.

Transmission: The principal focus of transmission investments relates to Siemens's summary and recommendation for CWL's N-1-1 challenge defined earlier in the Master Plan and described in greater detail of the Task Force Report for Chapter 6. Though Siemens makes a series of recommendations in its earlier analysis, it addresses the Task Force's specific request for an analysis of costs for non-wire alternative solutions. Non-wire projected costs are set forth in 8.1 and are projected to be more than 100% higher than the core group of alternatives discussed in Chapter 6.

Distribution: With respect to the distribution investments, the reporting is far more detailed than for the transmission summary. The Master Plan's distribution subsection begins by expressing a series of assumptions made by Siemens which are defined with the benefit of Siemens's technical expertise and experience pertaining to the establishment of: project prioritization methodology, unit cost and capital expenditure methodology, and CWL's overall capital expenditure budget –

Following the presentation of the various methodologies and resulting budgets, Siemens offers its recommended order of priorities of twenty (20) separate capital projects it considers necessary to complete over the next eighteen (18) years. Total projected costs are \$51 million with more than 80% of that figure recommended to be spent by 2025.

After offering its priorities for those capital projects, Siemens breaks down the elements of each project over a series of sections divided primarily between each project's anticipated principal components such as underground cable; feeders (new and existing); breakers and switches; distribution transformers; and capacitor banks.

### **B. Task Force Majority Opinions and Recommendations**

- The Task Force accepts the methodology provided for determining project prioritization and the various categories defining its composition.
- The Task Force accepts the methodology provided for determining unit costs in capital expenditures and defers to CWL staff for any divergence of opinions relating to costs.
- The CWL overall capital expenditure budget includes timing for expenditures that demonstrates that the Capital Projects analysis did not include a careful review or consideration of CWL's



financial condition or borrowing capacity. Projecting \$41.5 million in expenditures in the next 3.5 years is not realistic logistically or financially.

- In terms of the Siemens project prioritization methodology, the Task Force recommends deferring to CWL staff's existing process for determining capital improvement project priorities. While we agree with the Siemens methodology, some elements of that methodology may evolve or change when measured against the prospect of a modified timetable necessitated by CWL's logistical and-----\*\* financial realities/limitations. In such a case, the Task Force assumes that CWL staff will adjust and modify each consideration to assure that the influences of capital project decision making are up to date with the needs and challenges facing CWL at that time.
- Because the projected costs of the Capital Projects far exceed CWL's financial capacity to undertake and complete at this time, the Task Force recommends that City Council, Columbia Water & Light staff, and the Water & Light Advisory Board develop a capital plan and priority list for the Capital Projects to manage the financial divide between available resources and project needs.

### **Comment on Non-Wire Solutions (NWS)**

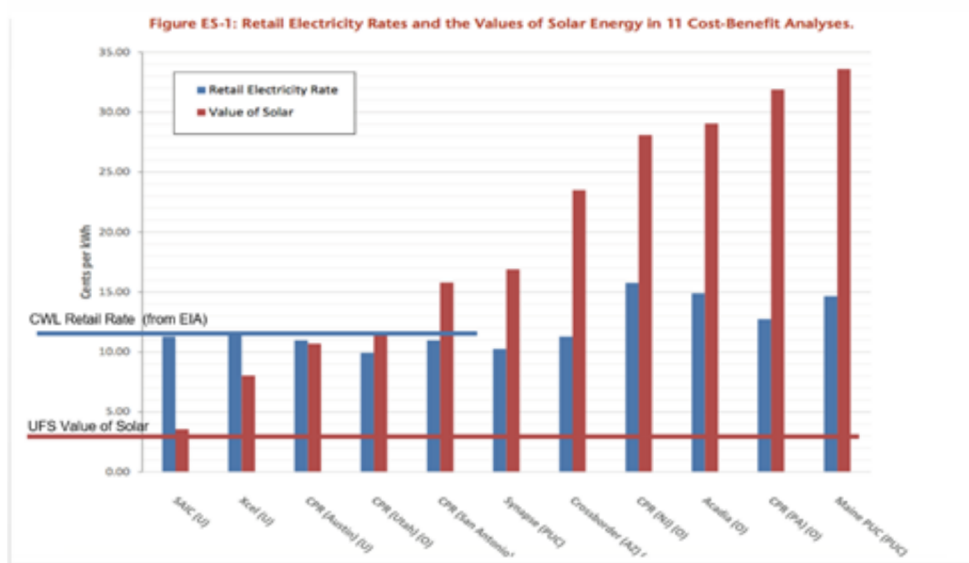
During the spring of 2021 Siemens was asked to add to their scope of work a review of the possibility of a Non-Wires Solution approach to Transmission and Distribution issues. The results of that are included in several references in their report. The following are comments/observations and recommendations by the Task Force on the NWS portions of the report:

- The Task Force was disappointed that the Siemens report was limited in its coverage of non wired solutions. In one instance, Siemens considers one configuration of a NWS, which is a photovoltaic and battery system at Perche Creek. The Task Force agrees that this particular NWS at this specific instance would be technically feasible, though not necessarily optimal.
- The Task Force would have liked to see more non-wire solutions and demand side management programs considered. NWS are programs, policies, and technologies that complement and improve operation of existing transmission and distribution systems and defer or eliminate the need for upgrades to the transmission and distribution systems.\*
- The Task Force believes that the full spectrum of NWS should be considered and implemented based on cost effectiveness. CWL has been successfully using NWS for many years, in the forms of efficiency programs, energy audits, solar rebates, etc. Our NWS have helped flatten our usage for 15 years, deferred or eliminated the need for more wires, and saved both the utility and the citizens money.
- The Task Force majority recommends an increase in the use of NWS, particularly with regard to building codes, distributed solar and storage, and a rate structure that incentivizes efficiency and conservation throughout all customer classes. NWS should be included in CWL standard engineering practices on a routine basis, at all scales.

\* *"Updating the Electric Grid: An Introduction to Non-Transmission Alternatives for Policymakers,"* USDOE, 2011

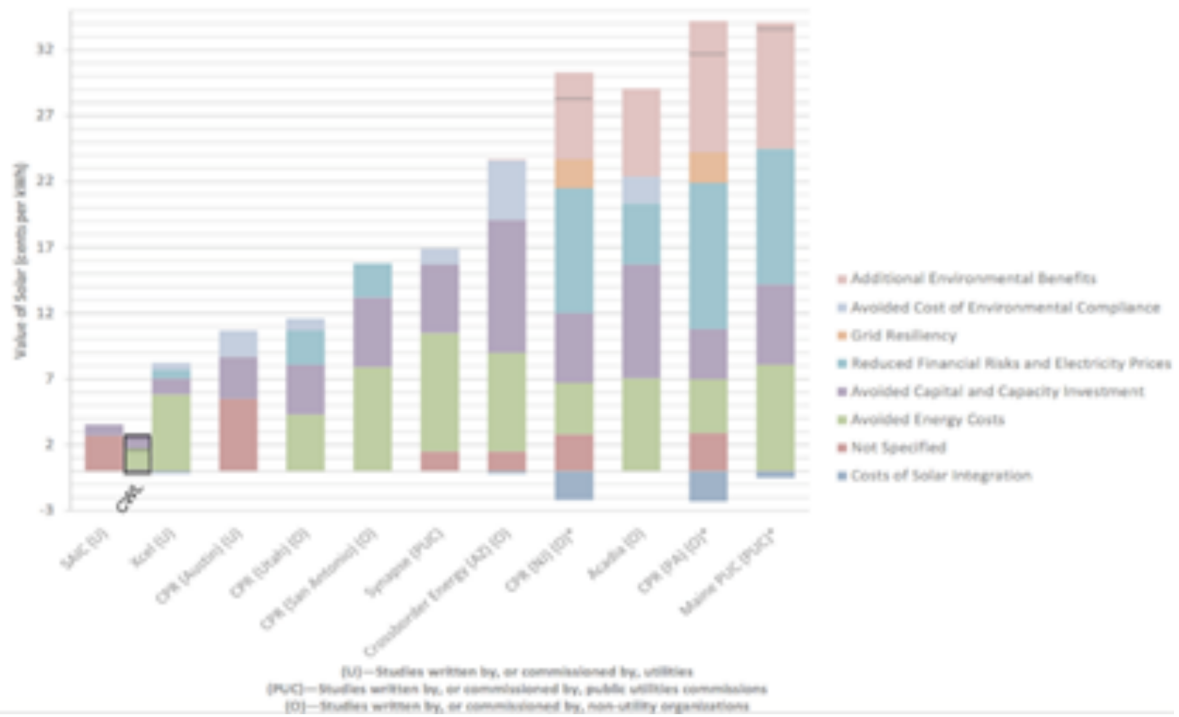


## Appendix A (Value of Solar Study)



Adapted from: Shining Rewards: The Value of Rooftop Solar Power for Consumers and Society, by Gideon Weissman, of Frontier Group, and Bret Fanshaw, of Environment America Research & Policy Center, October 2016  
**Modified to depict the value of solar in Columbia as identified by UFS in IRP Report by Siemens 2021.**  
[mahb.stanford.edu/wp-content/uploads/2016/12/77NYE-ShiningRewards-Rpt-Oct16-copy.pdf](http://mahb.stanford.edu/wp-content/uploads/2016/12/77NYE-ShiningRewards-Rpt-Oct16-copy.pdf)

Figure ES-2: A Comparison of Cost-Benefit Analyses of Solar Energy by Study and Category.



Adapted from: Shining Rewards: The Value of Rooftop Solar Power for Consumers and Society, by Gideon Weissman, of Frontier Group, and Bret Fanshaw, of Environment America Research & Policy Center, October 2016  
**Modified to depict the value of solar in Columbia as identified by UFS in IRP Report by Siemens 2021.**

[mahb.stanford.edu/wp-content/uploads/2016/12/77NYE-ShiningRewards-Rpt-Oct16-copy.pdf](http://mahb.stanford.edu/wp-content/uploads/2016/12/77NYE-ShiningRewards-Rpt-Oct16-copy.pdf)

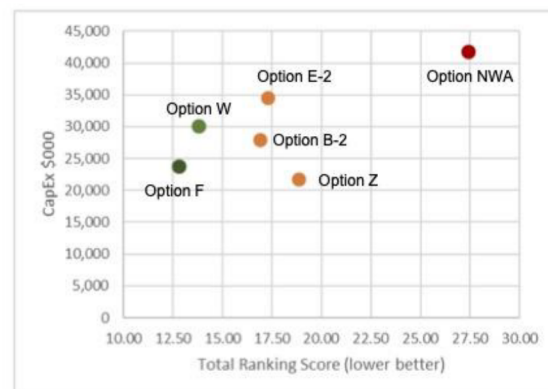
## Appendix B Task Force Members Poll on Transmission Options and Graphs from Siemens Analysis

	Siemens Option "W"	Siemens Option "F"	do nothing at this time	Siemens Option "B-2"	Siemens Option "NWA"	Siemens Option "E-2"	Siemens Revised "Option A" now called 'Z'
	rebuild existing 69kV Perche-Hinkson-Grindstone to include new 161kV line. Also upgrade Hinkson substation or relocate outside of floodway	creating an interconnect with Ameren 345kV line northwest of Columbia, and adding 161kV from that interconnection to Perche Substation	do nothing w/ transmission expansion at this time, ensure appropriate load shedding plan in place now, and reevaluate needs during next planning process	161kV line from Perche to McBaine, approximately 40% of this property is already owned by the City	30 MW of photovoltaic and 27 MW of energy storage at Perche Creek 69 kV. This option is added as a reference as it was analyzed in the Master Plan	Option E - north of town along existing Ameren route	161kV from Perche Creek to Grindstone, without a new substation
Task Force support for each option	10 out of 11	9 out of 11	9 out of 11	8 out of 11	2 out of 10	0 out of 10	0 out of 10
approximate distance of line	15.4 miles. (- 4 miles Perche to Hinkson and - 6 miles Hinkson to Grindstone )	15.4 miles. (~2 miles from interconnect to Perche and ~13.4 from interconnect to Bolstead)	N/A	~ 11 miles	N/A	~13.4 miles	~ 8 miles
meets NERC requirements	yes	yes	yes	yes	yes	yes	yes
meets potential n-2 contingency (rare circumstance where utility might be required to shed load)	yes	yes	yes	yes	yes	yes	yes
does it meet potential University of Missouri request for firm capacity	potentially	potentially	not likely	potentially	not likely	potentially	potentially
adds renewable to utility portfolio	allows import	allows import	allows import	allows import	yes	allows import	allows import
estimated cost	\$33,033,000	\$23,683,000	N/A	\$27,964,000	\$41,730,000	\$34,584,000	\$21,735,000

### Conclusions and Observations

SIEMENS

- Considering Cost and Ranking (see figure to the right) we observe that Option F seems to be the preferred with a capital level similar to Option Z but much better performance. It requires the CEC to address AECI overloads.
- Option Z is the least cost, but it requires the CEC, has high loadings and some overloads in AECI system under 2030 and High Load are not resolved and high
- Option W and Option B-2 have similar cost, but option W has much better performance and relies much less on the CEC to address AECI overloads.
- In summary and based on the above it is our opinion that CWL should pursue two parallel paths for the development of Option F and Option W.
- Option F has risk as it depends on agreements with Ameren and Option W requires expanding a transmission corridor in an urban setting, which has risks.



## Appendix C

### Task Force Mission Statement

Link to Council Resolution: [Adopted - R36-18A.pdf](#)

Task Force Duties *extracted from Council Resolution* :

SECTION 1. There is hereby established an integrated Electric Resource and Master Plan Task Force. Its purposes include the following:

- Assist City staff and City Council in the planning and rate-setting process associated with the preparation of an updated Integrated Electric Resource and Master Plan in 2018.
- Ensure public participation throughout the planning process.
- Review the forecasted capital needs and rate structure based on:
  - Capacity requirements;
  - System reliability;
  - Economic viability
  - Customer satisfaction;
  - Stakeholder needs;
  - Cost of service recovery;
  - System equity charge; and
  - Renewable energy.
- Determine the costs of expanding the capacity of the Electric Utility's transmission and distribution system to accommodate a growing number of customers, which includes:
  - A review of the current mechanism for recovering those costs;
  - A review of other potential strategies for recovering those costs, including, but not limited to the "system equity connection fee" method and "line extension policy"; and
  - Recommendations to City Council on how to recover those costs.
- Review the plan for continued compliance with established electric system planning criteria.
- Assist staff in developing projects and capital programs which implement strategic goals and initiatives.
- Assist staff in identifying specific generation, transmission, substation, distribution system, and distributed generation improvement projects, budgets and schedules.
- Assist staff in identifying long-range property and right-of-way acquisition requirements. Any other matters referred to the Task Force by the City Council.

## Siemens Scope of Services

Link to Siemens full contract: [Contract with Siemens Sept 2019.pdf](#)

Siemens Scope of Services *extracted from contract* :

### PART I – INTEGRATED RESOURCE PLAN:

1. Conduct a load forecast of at least 5 years, but preferably 10 years or more to determine the electric energy and capacity requirements of the City of Columbia as a whole. Develop a model for which the City of Columbia may run scenarios based on values of different variables. Include the model as a deliverable. Disclose all assumptions utilized in the creation of the model.
2. Review all current generation and capacity import contracts. Indicate when those contracts that will need to be renewed and/or that may be approaching end of life. Evaluate the status of the contracts and address the options available to the City of Columbia regarding these contracts. Evaluate the marketability of the contracts.
3. Review local generation assets. Predict useful life remaining of current local assets using existing condition assessments or prudent industry standards. Examine the viability of maintaining ongoing operation of existing generation and compare to building new local generation or increasing portfolio of import contracts. Examine the costs and benefits of converting a retired local generation unit from coal fired boiler to biomass fired boiler. Examine the cost and benefits to convert gas turbine units to combined cycle units for improved efficiency and added capacity.
4. Develop a resource utilization plan. Identify the utilization of resources and types of units selected to meet future needs and other factors of interest to permit an understanding of the potential future resource needs. In the plan identify strategies that would meet or exceed the minimum renewable energy and greenhouse gas emission requirements established by the City of Columbia. Existing goal is for 15% renewables at present; 25% renewables by 2023; 30% by 2029; and potentially 100% renewables at some future date within the next 40 years. Take into account results of the City of Columbia's Climate Action and Adaptation Plan currently in progress. Currently adopted community wide greenhouse gas emission reductions levels are: 35% by 2035, 80% by 2050, & 100% by 2060. Currently electric use is credited with 45% of emissions. Request for Proposal 140/2018: Electric Integrated Resource and Master Plan Page 7 of 10
5. Conduct sensitivity studies. Recommend sensitivities, to be examined. Include load growth, cost, reliability and resiliency, renewable expectations, climate regulation, and adoption of new technologies such as electric vehicle charging, increased use of heat pumps, and increased customer solar utilization as mandatory sensitivities.
6. Review current demand side reduction programs with regard to participation, participation potential, costs and results of the programs. Determine the appropriateness of existing demand and energy

### Appendix D Siemens Scope of Services (cont'd)

reduction programs and make recommendations regarding the continuation of these programs. Determine the impact to existing programs due to current and future state and federal efficiency

standards, rebates, or tax credits. Recommend any new programs or technologies that would increase the effectiveness of demand side and energy reduction programs.

7. Evaluate the potential for expanded use of private and public distributed generation and storage to contribute to the energy and capacity requirements of the City of Columbia. Examine the effectiveness and appropriateness of distributed energy resources such as, but not limited to, neighborhood and rooftop solar arrays, energy storage, and industrial customer generation as a means to curtail energy and capacity requirements.

8. Evaluate CWL's position as a MISO member vs. SPP. Evaluate and compare the availability of renewable energy in SPP and MISO.

9. Conduct a value of solar study. Evaluate how City of Columbia customers benefit from the proliferation of net metered solar including the solar incentive program costs and accounting for all costs, benefits, and opportunities involved.

### PART II – MASTER PLAN

1. Determine the load serving ability of the CWL service territory. Conduct a spatial load forecast to determine the localized load serving ability for various locations within the City of Columbia distribution service area. Take into account potential growth, redevelopment, and energy efficiency improvements, private solar generation, other private distributed generation, and proliferation of new technologies such as energy storage and electric vehicle charging stations when conducting the load forecast.

2. Determine the appropriateness of using battery storage, utility provided solar, or other distributed generation as options for serving local load serving ability needs. Include how these options could be used to prolong investments in the distribution system.

3. Review existing CWL standards for system reliability. Make recommendations to modify the City of Columbia electric engineering standards by taking into account economic viability, customer satisfaction, and best practices of the electric utility industry. Determine the risks associated with the standards. Document the standards in such a manner that they can be implemented as an official City of Columbia policy. Recommend a process in which standards are reviewed and updated. Document the Request for Proposal 140/2018: Electric Integrated Resource and Master Plan Page 8 of 10 NERC function types for which the City of Columbia is registered. Evaluate the appropriateness of each of these registrations.

4. Make recommendations regarding the expansion of the City of Columbia transmission system. Recommendations must take into account established NERC and other regulatory standards, requirements of the MISO ISO and established or modified CWL standards for system reliability. Evaluate CWL's transmission system as a MISO member bordering SPP and AECI territories and determine how that affects regulatory requirements. Address the needs of the transmission level interconnections with the University of Missouri and City of Fulton when making the recommendations.

5. Make recommendations regarding the expansion of the City of Columbia distribution system. Recommendations must take into account existing or modified standards for system reliability. Take into account the localized growth of the system to determine recommendations regarding how to provide adequate capacity for that growth.

6. Review the capital projects currently forecasted by CWL and determine if they are in keeping with the recommendations established by the master plan. Identify projects that may be unnecessary. Identify



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projects that might be considered to meet established recommendations. Determine the prioritization of these projects.

7. Review the costs and benefits of adaptation of AMI metering or other “smart-grid” technologies.

### Appendix E

#### Chronology of IERMP Meeting Dates

<b>2018</b>	7/11/18	9/27/18	10/25/18	11/12/18	
<b>2019</b>	1/24/19	2/4/19	2/11/19	2/28/19	3/14/19
	3/19/19	4/9/19	4/16/19	5/23/19	6/5/19
	7/25/19	8/22/19	10/1/19	10/24/19	11/13/19
	11/21/19	12/9/19			
<b>2020</b>	1/14/20	1/23/20	2/27/20	7/8/20	7/30/20
	8/12/20	8/27/20	9/23/20	10/28/20	11/12/20

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	11/17/20	12/15/20	12/23/20		
<b>2021</b>	1/6/21	1/28/21	2/16/21	2/25/21	3/16/21
	3/25/21	4/15/21	4/28/21	5/13/21	5/17/21
	5/27/21	6/24/21	7/22/21	8/26/21	9/1/21
	9/23/21	10/7/21	10/14/21	10/28/21	11/3/21

Highlighted notes indicate recommendations that task force identified as priorities: